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VOLUME 21 May - 1963 No. 6

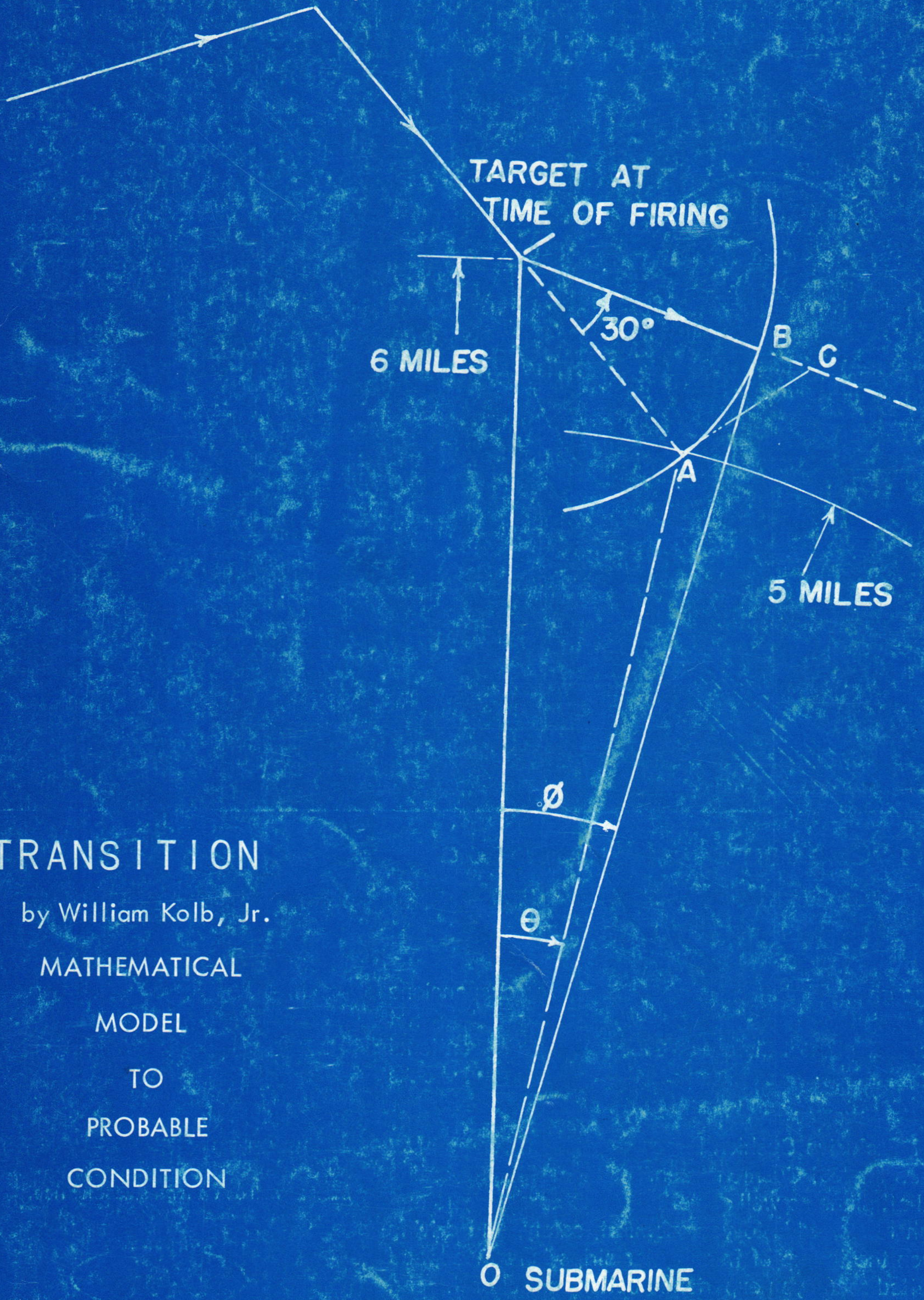

TARGET AT
TIME OF FIRING
6 MILES
30°
B
C
A
5 MILES
ø
θ
O SUBMARINE

FIGURE 1

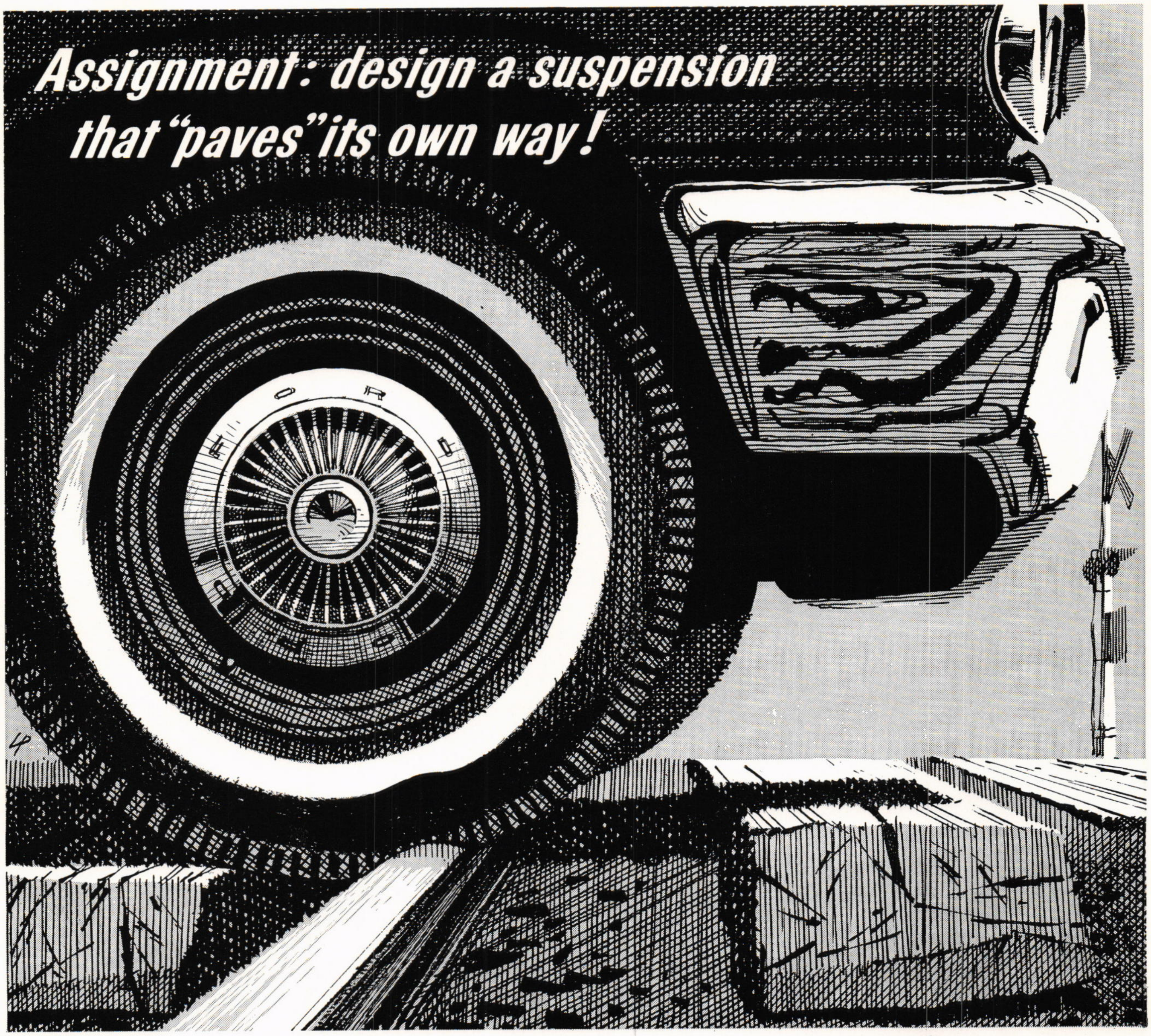
TRANSITION

by William Kolb, Jr.

MATHEMATICAL
MODEL
TO
PROBABLE
CONDITION

THE GEORGE WASHINGTON UNIVERSITY

MAY 1963

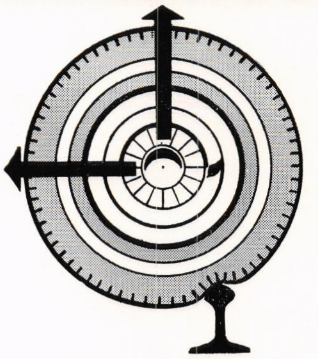


Result: "Cushion Recoil" provides a dramatically smoother ride in 1963 Ford-built cars

The challenge given Ford engineers was to design suspensions that would permit wheels virtually to roll with the punches—not only in a vertical plane but fore-and-aft as well. Conventional suspension systems provide only a partial solution to road shocks by limiting wheel recoil to an up-and-down motion.

The solution? Exclusive Cushion Recoil suspension design in all Ford-built cars for '63! Cushion Recoil, with cushioning action in a fore-and-aft plane as well as vertical, smothers the jars and jolts of rough roads, adds to your comfort, safety, and driving pleasure. Even the thump of freeway tar strips is reduced, and on deeply rutted roads you experience better control of the car. Furthermore, your Ford-built car is spared the wear and tear of road-induced vibration.

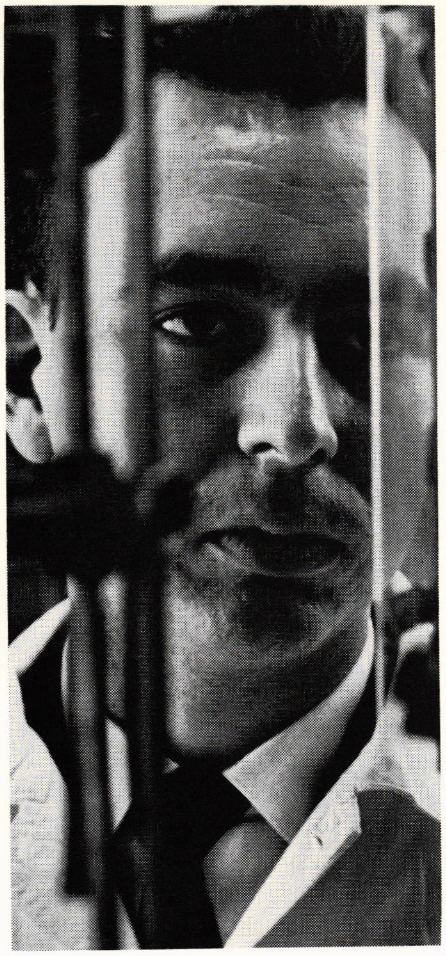
Another assignment completed—one more example of engineering excellence at Ford and new ideas for the American Road.



SOAKS UP ROAD SHOCK. Exclusive Ford Motor Company Cushion Recoil action moves back as well as up for a smoother ride.

Ford
MOTOR COMPANY
The American Road, Dearborn, Michigan

**WHERE ENGINEERING LEADERSHIP
BRINGS YOU BETTER-BUILT CARS**



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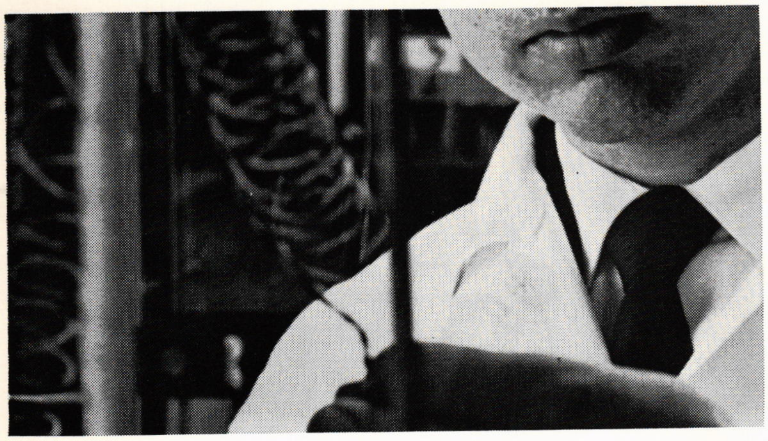

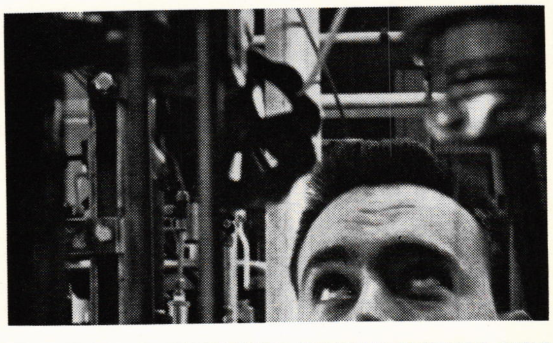

IN ADDITION TO FAR-REACHING PROGRAMS INVOLVING FUELS, LUBRICANTS AND PETROCHEMICALS, AMERICAN OIL AND ITS AFFILIATE, AMOCO CHEMICALS, ARE ENGAGED IN SUCH DIVERSIFIED RESEARCH AND DEVELOPMENT PROJECTS AS:

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AMERICAN

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Editorial Comment

CULTURE AND THE ENGINEER

During their pursuit of an education at The George Washington University, engineering students experience the stigma of the uncultured. While there are some individual exceptions, the great majority of engineers encounter a less than cordial attitude from other members of the university community. It is only natural that engineers isolate themselves from liberal influences when they encounter resistance to broadening attempts.

A definition of culture is necessary before the terminology can be applied to specified groups of people. Matthew Arnold has defined culture as "knowledge of the best that has been thought and said in the world." Thomas Henry Huxley, a contemporary of Matthew Arnold, has defined the essence of culture as a criticism of life. Therefore, it seems quite credible that culture is properly defined without reference to science or the arts. It should also be clear that culture can be obtained equally well through the scientific or classical approaches. Ideally though, a most comprehensive criticism of life would be obtained through familiarity with both disciplines.

Now that the concept of culture is defined, it follows logically that classical and scientific approaches should be examined for the purpose of determining their relative merit. It is evident that students may obtain an adequate cultural background through studies of liberal arts. The Great Books contain a wealth of information which provides an adequate base for a cultural education. However, understanding the concepts involved in the classical literature is often impeded by a lack of familiarity with the scientific approach to education. Students who adhere to the classical approach without the aid of scientific knowledge encounter considerable difficulty in obtaining their goal.

The same problems exist for persons who would achieve cultural competence by the scientific process. Although the rudimentary ideas are present, as in the classical literature, gleaning them from the superfluous can be achieved only with considerable effort. Criticism of life is found in scientific works in a very subtle context and can be easily overlooked. For this reason, we have scientifically competent students who are not fully aware of the cultural advantage to be gained from their books. Scientists and engineers can eliminate the stigma by obtaining an insight into the classical thoughts and writings. In addition, students versed in liberal thinking will gain greater insight from their reading of scientific works.

A strong argument exists for obtaining a thorough understanding of both the scientific and classical approaches to cultural competence. However, many students will persist, for one reason or another, in following only one of the dual approaches. Progress of this type usually results in misunderstanding of the cultural worth of its counterpart, and thus creates a significant problem. The only solution is for proponents of classical culture, as well as proponents of the scientific method to recognize that the alternative exists. After recognizing this, all students would find themselves stimulated to broaden their cultural attainment, thus decreasing friction between the factions involved.

—D. L. J.

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TRANSITION

The transition from the idealistic problem solving environment of the student, to the realistic environment of the engineer can result in trauma in the unprepared student. Problems and experiment, carefully selected to provide the student examples of what he CAN do, are inadequate in presenting explicit examples of what the theory or practice CANNOT do. However to state a problem without suggesting a solution is not the intent of this paper; rather it is intended to present an example of real world conflicts and the method often employed to survive in that environment.

The basis for most actions is usually (and preferably) measurement. Lord Kelvin has said "if I can measure it, I can understand it". Unfortunately there are degrees to which measurements can be obtained. For example, the precision theodolite, measuring angles, can resolve a circle into 10-second increments of arc. This error amounts to:

$$(10/60)(1/60)(1/360) = 1/129{,}600$$

approximately 8 parts in one million

This seems like extreme precision until one considers the latest time and frequency measurement equipment. It is common practice today to measure radar signals to milli-microseconds (one nanosecond). This is equivalent to a resolution capability of:

ten parts in one thousand million

Clearly three orders of magnitude better than our precision theodolite. However, before we rush off into the realm of invention, seeking a method of angular measurement capable of resolution equal to that of the time measurement, let's examine the application requirements using a "real world" situation.

EXAMPLE: A torpedo is to be fired from a submarine at a target six miles away. The target is maneuvering in an erratic manner to minimize the likelihood of being hit by a torpedo. The torpedo will travel at 40-knots to a predicted intercept at five miles. At 40-knots the torpedo will require:

$$\frac{5(\text{n.m.})\ 2080(\text{yd/n.m.})}{40(\text{kn.})\ 33.78(\text{yd/min-kn.})} = 7.7 \text{ minutes}$$

(n.m. = nautical miles)
(kn. = knot = n.m./hr)

to reach the predicted point of intercept. Realizing that the maneuvering target could be (assuming a zig away of 30° at some time during the torpedo flight)

$$12(\text{kn.}) \times 7.7(\text{min.}) \times 33.78(\text{yds/min-kn.}) \times \sin 30^\circ =$$

$$1621 \text{ yds}$$

away from the predicted intercept point, we decide to control the torpedo during its flight and to guide it onto a new intercept when it reaches the initial intercept point. To do this we will require two things: (a) a measured knowledge of the new target position (thus requiring our old friend the "theodolite") and (b) a knowledge of the actual torpedo position. Figure 1 illustrates the problem geometry. In this figure you will note that the target has made a zig of 30° at the instant our torpedo was fired, and that the torpedo has been dead-reckoned to a point near the initial predicted point of intercept. We can now examine our need for a bearing measurement and the precision required of our theodolite. At the time in question, the target is at (B) and moving toward a new intercept point (C). If we measure the bearing line to the target at point (B) with an accuracy of 15-yards at the target, we will require a bearing resolution of:

$$\Delta\phi = \arctan\frac{15\ (\text{yds})}{11{,}752\ (\text{yds})} = .001276^\circ = 4'\ 24''$$

Clearly this does not require the invention of a super theodolite. In fact, we can now begin to question the wisdom of using a conventional theodolite of 10-second accuracy. Using a fresh approach, we shall investigate the accuracy with which we shall be able to define the position of the torpedo at (A)? We have dead reckoned the position of our torpedo by using the following computations:

$$X(A) = X(O) + \int_{O}^{7.7} Sz \sin\theta \, dt$$

$$X(A) = Y(O) + \int_{O}^{7.7} Sz \cos\theta \, dt$$

where: Sz = torpedo speed

In the assumed (but highly unlikely) situation where our computing equipment is exactly right, we shall still have some uncertainty in our knowl-

by William Kolb, Jr.

William Kolb, B.S.E. '65, is a part time student in the School of Engineering and Applied Science. Married and the father of three boys (one a sophomore at V.M.I.), Bill has worked 25 years for the Navy Department. Although his campus activities are necessarily limited, Bill has been elected President of Xi Chapter of Sigma Tau Fraternity for the next year.

"Transition" was the runner-up entry in the fall pledge paper contest.

edge of the torpedo position near point (A). This uncertainty is the result of random errors which cannot be compensated for or adjusted out of the problem. Examples of these are: drift of the gyroscope in the torpedo due to friction or unbalance, initial setting error, yawing thru the water due to misaligned control surfaces, etc. In our example we will assume that the total error in our knowledge of the torpedo position near point (A), and the uncertainty in our measurement of the target's new position at point (B), will be the controlling factors in our calculation of a new intercept course for the torpedo to point (C). Assigning symbols to the major sources of random error:

e_1 = theodolite error in measurement of target position (B)
e_2 = torpedo initial setting error (error in setting θ)
e_3 = torpedo speed error
e_4 = torpedo drift error

Errors e_2 thru e_4 represent error in the dead reckoned position of the torpedo and will form the basis for our estimate of the allowable error for the theodolite, e_1. We have defined these errors as "purely random" and an explanatory note is in order. Random in this instance will define the distribution of the individual effects about a mean effect; where the mean effect does not influence the result as either a function of time or position of the mean effect in the range of permissible values. Such a distribution is called a "normal", "Poisson", or "Tchebycheff" distribution. Reference (1) contains further information on the distribution of randomly occurring events. The next problem is to determine the manner in which our random effects contribute to the uncertainty in dead reckoning the torpedo position (A). Probability theory provides a good statistical tool for the engineer at this point. It can be shown that the most probable error resulting from the combination of several random errors is:

$$E_n = \sqrt{(e_1)^2 + (e_2)^2 + (e_3)^2 + \dots + (e_n)^2}$$

Assuming values for the random errors, e_2 thru e_4, in our example:

$$E_n = \sqrt{(\quad)^2 + (6)^2 + (4)^2 + (12)^2} = 14 \text{ (Minutes)}$$

where the theodolite error has been intentionally omitted. To get the answer to our original question, "what angular precision is required of our theodolite"? one simply uses a value of (e_1) such that E_n is not seriously effected by the introduction into the RSS (root of the sum of the squares) equation. In our particular example this would be determined by arbitrarily assigning an incremental change ΔE_n to the initial E_n, where ΔE_n is arbitrarily chosen to be 5%, our equation becomes:

$$E_n + \Delta E_n = \sqrt{(e_1)^2 + (e_2)^2 + (e_3)^2 + (e_4)^2}$$

Squaring both sides, and neglecting products of infinitesimals:

$$(E_n)^2 + 2(E_n)(\Delta E_n) - (e_2)^2 - (e_3)^2 - (e_4)^2 = (e_1)^2$$

And finally:

$$e_1 = 4\text{-}1/2 \text{ minutes}$$

This result is often surprising to the new engineer, i.e. that 4-1/2 minutes precision is adequate for our theodolite, and in the realization of the nature of the real world incapability to work precisely. It is surprising to realize the futility of applying precision measuring equipment to real world situations.

To avoid alarm over the seemingly poor performance of torpedoes, it should be mentioned that wars are NOT fought on the basis of achieving a 100% probability of kill for each weapon fired. Indeed if they were, the earth would have been decimated long ago. Instead, reasonable kill probabilities are accepted. Reasonable being usually defined as "the kills beyond which the enemy will no longer desire to continue fighting". In our example, the most likely position of the torpedo was determined to be at a point 42.5 yards from point (A). It should be noted that this represents another statistical distribution in which 63% of the time (for this particular torpedo and problem geometry) the torpedo will be in a zone ±42.5 yards from point (A), and centered about point (A). Since our target is about 200 yards long, we will be able to hit our target almost 98% of the time.

By this example it should be evident that there is a necessary transition between the precise problem solving environment of the student and the real world environment of the engineer. The statistical discipline provides the tool to make this transition. All engineering students should welcome the opportunity to learn and apply the statistical methodology.

---

(1) "Statistical Quality Control" -- E. L. Grant -- McGraw Hill Co.

THE NEW SCIENCE

With the rapid technological advances in the computer industry today, managers no longer have to base their decisions wholly on their intuitions and feelings. The computer has helped with the decision-making process, but tomorrow it may perform it. The mere suggestion that an inanimate object will soon make decisions has aroused much resentment among businessmen. Studies are currently under way in this field of management to duplicate the decision-making process on a large, fast digital computer.

The problem of decision making is that of determining the course of action which will most likely produce the desired results according to some predetermined criteria; these rules and criteria being determined according to the expected forecasts. Today the decision-making process is carried out with more logic than ever before. This is due to the "scientific decision-making" process in which real problems are based upon mathematical terms that describe the situation. Thus, the mathematical decision made by the computer, represents the solution to the problem. This use of electronic computers and data processing machines to aid in decision-making and the other fields of business activity is called "Electronic Data Processing." In this article we will concern ourselves with the management decision-making operation of Electronic Data Processing (E D P).

The computer can be used to screen all the data that is to be used in making a decision and present it in statistical form for easier comprehension during the decision-making operation. Since there are many repetitive operations, the use of the electronic computer to aid in their solution, month after month, may result in appreciable savings over a period of time. The major activities of the electronic computer are: activity of policy making, and/or action necessary to carry out the policy. We will look at both of these aspects in studying E D P.

Any decision making process can be described in terms of data collection, information processing, and decision making. Data that reflects events and the desired objectives, is the basis for all decisions made. More specifically, the decision-making process involves the following steps:

1. The recognition of the problem and collecting the data or relevant material from various sources and forming them into mathematical "models."

2. The evolution of the mathematical "models" of the decisions from the results of the computer.

3. The making of the decision based upon the data from the computer. Another way in which the computer aids management is in its ability to compare different decisions made by management and from previously defined objectives, it reflects the decision which is closest to the optimum.

Today it is possible for the computer to take "action" instead of acting merely as a "helper" for management. This "action" is called "internal decisions." Here, "internal decision" means that a computer is programed to take appropriate action within the company. This action may include issuing instructions to a clerk or to a manager, or it may involve preparing documents--purchase or production orders--for distribution. Even physical action--starting, changing, or shutting off a production line--can be taken if both the computer and factory operations are automatic.

As mentioned earlier, the computer solves problems analogous to real situations. Thus, the computers would benefit management by affording it training in presenting many different industrial circumstances comparable to the real situations. Another advantage is that these simulations aid the study of the process and factors influencing the economic development of a corporation. This process is called "Industrial Dynamics." Still further, important generalizations can be deduced from the progress reports and results of the computer simulations. But the advantages made by a computer can not be obtained if the data or assumptions made by management in programing the computer are incorrect. The computational capacities of computers

OF DECISION MAKING •

by Clifford B. Stearns

will not eliminate any wrong assumptions that may be present in the model itself.

One interesting illustration of how computers benefit a corporation in making decisions on future planning is found when five years of a corporation's operations are simulated in one day. In this case, decisions are made by different executives in the various departments of the company. In illustration, these decisions might be on:

1. Price of product
2. Producing volume
3. Advertising expenditure
4. Research and development expenditures
5. Amount of new investment in plant equipment
6. Dividends to be paid, etc. . .

These decisions are made by each of the executives for a quarter of a year. The computer then computes the interaction and effects of these decisions on the market; it simulates what may happen in reality and produces for each executive a report giving:

1. Sales volume
2. Per cent of the total products sales handled by the company.
3. Production capacity of the firm for the next quarter
4. Statement of receipts and disbursements
5. Statements of financial conditions, etc...

Based on the study of its report, each executive then makes decisions as to how the firm will operate in the next quarter.

Another method that is quite common in high levels of organization is the "means-ends analysis." This method uses the computer to foresee changes in the company's organization activities. The computer compares the job descriptions of the different positions in the organization to the qualifications of the men seeking the positions. The computer selects men to occupy these positions based upon the data fed into it and the assumptions made by the programmer. The "means-end analysis" is a design process where certain goals are defined and associated with these goals and methods for attaining them.

One aspect of the computer that is not often discussed is its ability to correct mistakes made by the management in its decision process. Errors in the results can only be attributed to incorrect data or to rules by which the data was programed. Because of the speed of computer, management is able to detect its errors early. In addition, computers can process a greater quantity and degree of relevant data in a given space of time and hence, permit a more accurate picture of the situation to be described.

Even in Electronic Data Processing there are significant limitations. While it is agreed that computers make decision making more scientific, they will not improve solutions to uncertainty; value problems must ultimately be determined by man, unless man wants to live in a computer culture. Other limitations exist because of human qualities. People are reluctant to change to the scientific method of decision making. Also, managers must agree in advance to decisions they would ordinarily make in a great variety of circumstances; for this reason, managers seldom do make the necessary decisions.

Even with its limitations, the digital computer's ability to make logical decisions gives it the necessary advantage that is needed to solve complex problems. In fact, it is possible that computers in the future will have the capacity for "heuristic" (discovery) problem solving which may lead to something that approximates the brain. As near as 1967 it is predicted that a computer: (1) will be the world's chess champion (2) will discover and prove an important mathematical theorem; and (3) will write music of considerable aesthetic value.

With the aid of the computer, new doors will open, giving management a better understanding of the decision-making process. Decision making will be based on the evaluation of a wider range of alternatives and of current facts, rather than on intuition and the "extrapolation of historical data."

"SOME THINGS OLD - - SOME THINGS NEW"

Edited by Judith Popowsky

One who receives the privilege and honor of delivering the Frank Howard Lecture becomes at once highly conscious of the necessity to say something of importance -- and of the limitations of his own capability. He realizes that inevitably his efforts will reflect much of his own inner thoughts, and reveal a distressing exposure of his inadequacies. It is with a lively realization of these facts that I speak to you about education, specifically education of engineers.

Where does one start when discussing education -- and particularly the education of engineers? This is not a simple choice, for the conclusions one reaches are intimately related to the point from which one starts. I choose to reach not quite into antiquity for my point of departure, selecting sometime in the early eighteenth century when formal education in the United States was just beginning, and when the scholars of Europe were quite sure their educational institutions and formal procedures had reached a highly satisfactory state.

YESTERDAY

To refresh our background knowledge, it is noted that during the Medieval University period (13th to 16th century) science and its derivatives were almost totally neglected by the scholarly world. Educational institutions were largely church created and dominated, and devoted their major attention to scholarly examination of theology, law, philosophy, occasionally medicine, and among a few, mathematics with particular reference to astronomy. The tremendous development of engineering and science (in that order) under the Romans was forgotten if not lost.

In the late 17th century the need of a few persons interested in science to exchange views and ideas led to the formation of several scholarly scientific societies, who contributed little of knowledge to either science or engineering, but did kindle among university scholars a spark of interest in science. The spark was blown to flame by the need of Louis XIV of France for a stimulated economy and improved commerce. Canals were to be dug, manufacturing encouraged and improved, roads and structures had to be built. The universities of the day had nothing to offer, so Louis formed a government agency, the Corps Royale des Ponts et Chaussees, (Department of Bridges and Roads), in 1747 to get done those things which were needed but for whose doing no one was trained. It was staffed in part with the university scholars whose interest in science had earlier been aroused by scientific societies, and in part by practicing engineers. Students were employed by the government, and their assigned duties were to attend school. There resulted the probable first school of engineering of modern times -- the Ecole des Ponts et Chaussees.

This school started a fashion, in substantial part because it succeeded in satisfying a vital need. Within the period 1747 to about 1814, there appeared German, Russian, and Scottish versions of engineering schools. The infant United States imported and copied the European university, primarily to serve church needs, but did not adopt the engineering schools. There were twenty-seven colleges chartered in the United States prior to 1800 -- among these the best known remaining are Harvard, Yale, Pennsylvania, William and Mary, Princeton, Rutgers, Columbia, Dartmouth, and Brown. Contrary to their European forebears these citadels of scholarship and liberal education embraced science as an important part of the curriculum.

In fact, science occupied from one-third to something more than a half of the required studies in the liberal education curriculum. For instance, College of William and Mary requirements for the Bachelor of Arts degree in 1792 were: acquaintance with the 1st, 6th, 11th, and 12th books of Euclid, trigonometry, surveying, algebra; a knowledge of the general properties of matter, mechanics, electricity, hydrostatics, optics, and the first principles of astronomy; an acquaintance with logic, belles lettres, rhetoric, natural law, and the general principles of politics; and a competent knowledge of geography and of ancient and modern languages. I leave to you interpretation of the distinctions between acquaintance and knowledge, remarking however that this description bears a striking resemblance to American engineering school curricula of a few years ago.

About this time there developed in the United States a counterpart of Louis XIV's needs of half century earlier. The burgeoning young colonies had cut their economic, political, and cultural umbilicals to Europe, and were faced with the stark necessity to dig canals, build roads, start manufacturing, improve trade, and build structures.

by Martin A. Mason,
Dean
School of Engineering and Applied Science

Engineers were needed but there were few so trained. A handful were imported from England, France, and Germany; some several ingenious and bright mechanics, artisans, and craftsmen developed themselves by seeking experience with the imported engineers. Most importantly many of the science professors and their students, whom you will recall were products of or associated with liberal curricula having 1/3 to 1/2 or more science content, became the engineers that were needed.

This was the beginning of engineering in America. It was not long before the rapid growth of the need for engineers led to consideration being given to forming schools specifically for educating engineers.

The first action was in 1802 when the Federal government established the U. S. Military Academy as this country's first engineering school. During the next few decades the engineering school developed its distinctive character and became firmly established as an educational entity.

Thomas Jefferson proposed a state school for Virginia in 1814, where every brand of science deemed useful at that day should be taught in its highest degree.

Governor Ethan Brown proposed to the Ohio legislature in 1819 the appointment of a chemist and a civil engineer, stating "that it appears practicable, should the legislature think proper to employ these two characters, to render them doubly useful by making them professor and principal instructors in a polytechnic school - - - for instruction in the theoretical and scientific principles of the most useful arts".

By 1862 there were seven engineering schools in the United States, being Rensselaer, Union, Harvard, Yale, Dartmouth, Michigan, and Columbia; Massachusetts Institute of Technology was incorporated in 1861 and was just accepting its first students. As distinct from the professional schools of theology, medicine, and law which had developed largely as proprietary and sometimes profit-making ventures, the professional schools of engineering were almost exclusively parts of academic educational institutions. The dominant influence in the schools was the classical academic community; the voice and impact of the profession itself was hardly known in the schools. It was into this situation that the Federal Government introduced the Morrill Act of 1862.

The Morrill Act with its land grant opportunities, and the concurrent formation of societies of practicing engineers in the 1850-1870 period, profoundly modified engineering school development, organization, and philosophy in the United States. The established colleges recognized well the advantages to them from the Morrill Act provisions if they formed engineering schools in their colleges. It was this widespread establishment of engineering schools within the academic structure of existing colleges and largely with existing academic personnel, that effectively prevented any further development of engineering schools in the pattern of the separate professional school characterizing law and medicine, although the absence of any organized effort by the engineering profession must have been a contributory factor.

From their founding day the engineering societies evidenced their concern with engineering education, but it was to be many years before they had any discernible influence on the classical educators who controlled the engineering schools. In 1872 the societies finally made their voices heard at a joint meeting of the American Society of Civil Engineers and the American Institute of Mining Engineering at the Philadelphia Exposition. At long last the battle was joined -- the profession found the schools far from acceptable and lent their pressures to those of the needs of industry in seeking improvement.

In 1893 the third major force influencing American engineering education appeared with the formation of the Society for Promotion of Engineering Education by some seventy school men. The society grew slowly with its membership remaining predominantly academic. We know it today as the American Society for Engineering Education.

TODAY

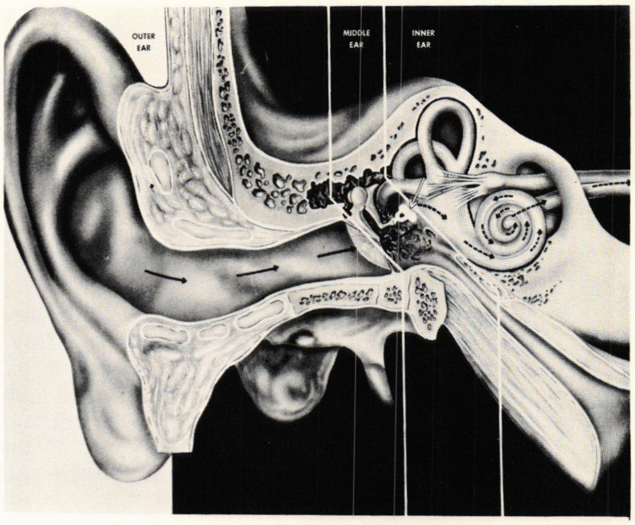
This is the parentage and background of American engineering education. Where are we today?

The early colleges in which American engineering education was born by science faculty members, have grown and coalesced into universities with attendant vertical and horizontal expansion. In the expansion the engineering

—Continued on Page 13

TECH NEWS

"STAPEDECTOMY"



The stapes bone – cause of numerous cases of defective hearing – is shown in the middle ear section of this cutaway photopraph. The bone – smallest in the human body – is indicated by the black and white arrow. Special instruments, many made from Allegheny Ludlum Steel Corporation stainless steel, are used to remove the bone and correct the hearing defect.

The stapes bone -- smallest bone in the human body -- is causing an estimated 3,000,000 Americans to have trouble hearing. The afflicted are suffering from otosclerosis but there is hope -- greater today than ever before in these cases.

Because of a relatively new operation -- stapedectomy -- 90 percent of the victims will regain normal hearing. Little more than a decade ago fewer than 10 percent would have enjoyed any long-term benefit. Much of this progress is due to new techniques and new stainless steel surgical instruments.

Otosclerosis means the tiny stapes bone, located in the ear, no longer can vibrate to transfer sound. This condition is caused by an abnormal growth of bony tissue.

Normally the stapes bone transfers sound from the eardrum to the organ of hearing inside the ear where sounds are converted to nerve messages and relayed to the brain.

Surgical efforts to correct otosclerosis have been recorded as early as 1870 when a German doctor attempted to free the stapes bone. But refixation of the stapes soon occurred and hearing was short lived.

Today highly-trained surgeons equipped with specialized instruments completely remove the stapes bone and replace it with stainless steel wire or plastic tubing or a combination of the two.

Storz Instrument Company, St. Louis, Mo., produces custom-made instruments for nearly every American surgeon who now performs the delicate stapedectomy. Many of the instruments are made from Allegheny Ludlum Steel Corporation stainless steel.

A recent survey disclosed there are only enough trained surgeons in the United States to perform about 5,000 stapedectomies a year. There are about 20 centers in the country where the majority of the operations are performed.

Despite the limited number of surgeons, there are various techniques for correcting otosclerosis. But all of the variations deal with inserting the wire or tubing in the ear.

Dr. John J. Shea, Jr., Memphis, Tenn., pioneered removal of the stapes bone and insertion of a polyethylene tube. Dr. Harold Schuknecht of Boston, Mass., introduced the wire strut.

Dr. Raymond E. Jordan, Pittsburgh, uses a combination of polyethylene tubing and stainless steel wire. He feels it holds the insert more securely in place.

Some surgeons prefer to use a small sliver of fat, taken from the patient's earlobe, to graft the insert in place. Others use a piece of vein removed from the patient's arm.

The entire operation, Dr. Jordan says, requires about 45 minutes to 1-1/2 hours. He uses 15 different instruments to remove the stapes bone and replace it with the tubing and wire insert.

To perform the operation the surgeon uses a microscope that directs his sight into the ear and magnifies the area six to 45 times its normal size.

Using these relatively new techniques, the competent surgeon is able to restore hearing in the vast majority of people whose hearing loss is due to otosclerosis.

The one major drawback today is the limited number of operations being performed each year because of the lack of trained surgeons.

Dr. Jordan said there are an average of 60 new surgeons a year completing the specialized training to perform stapedectomies.

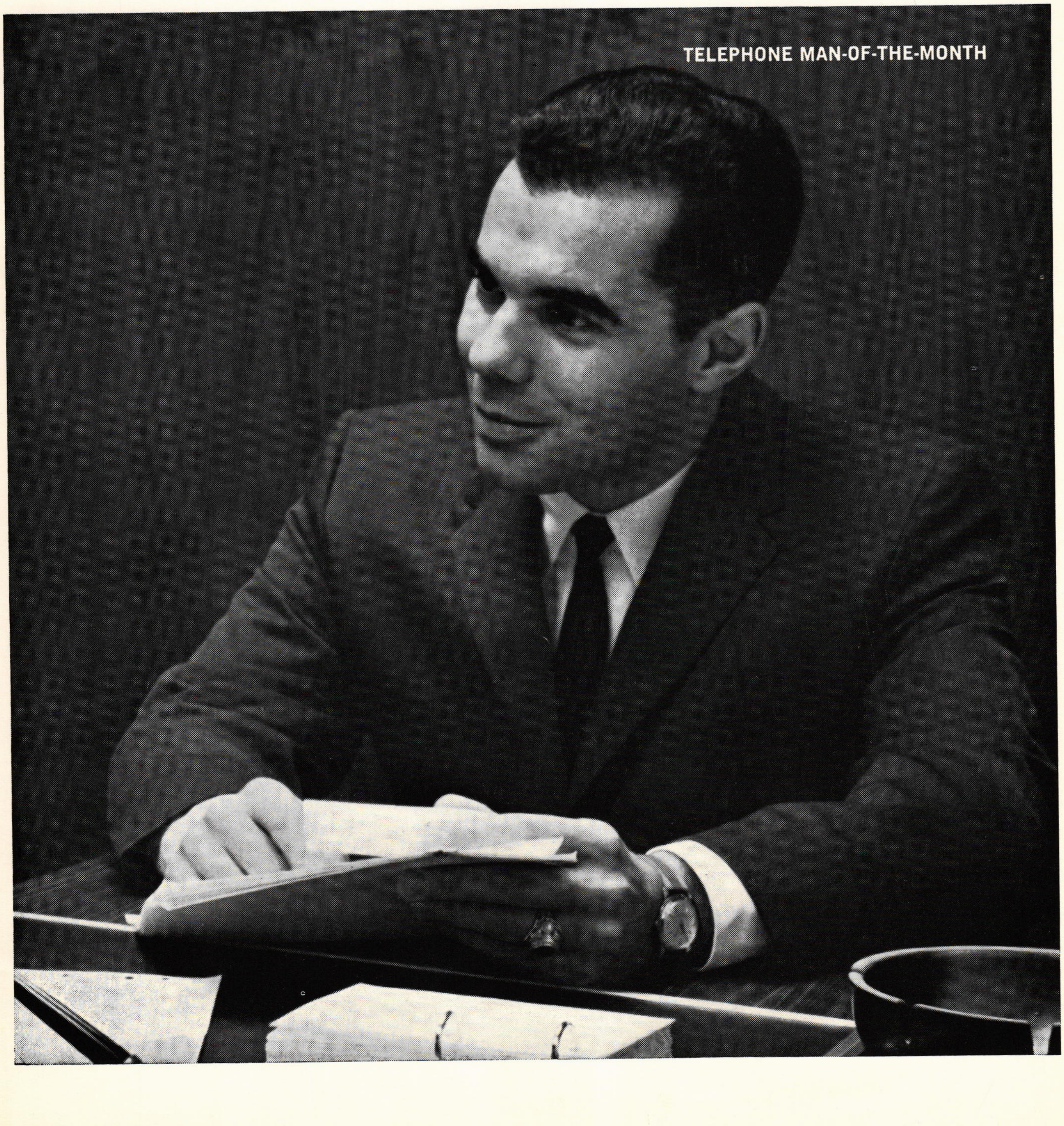
THE BELL TELEPHONE COMPANIES SALUTE: JOE AMWAKE

Joe Amwake (B.S., 1959) is a Sales Engineer with the Long Lines Department of A.T.&T. Joe supervises five people who are responsible for the sale of intercity telephone services in the state of Alabama. Quite a responsibility for a man who's been in the business only three years.

Joe had demonstrated on earlier assignments that he could handle responsibility. For instance, on his first telephone job he coordinated the installation of new teletypewriter services in Detroit. This earned him his job as Sales Representative where he contacted important network television customers, among others. Then came his latest step up.

Joe Amwake and the other young engineers like him in Bell Telephone Companies throughout the country help bring the finest communications service in the world to the homes and businesses of a growing America.

BELL TELEPHONE COMPANIES



TELEPHONE MAN-OF-THE-MONTH

MECH MISS

MARY BUKOVE

On May 3, 1963, the University May Day Queen will be chosen—but we have one of our own, Miss Mary Bukove. Among her more prominent accomplishments in her two short years at G.W. are membership in Delta Gamma, participation on the committee for Colonial Cruise, active duty as a Big Sis, and, of course, Engineers' Queen for 1963-1964. Although she intends to major in sociology, this Arizona-born lass hopes to attend business school in California during summer vacation.

SIGMA TAU

"SOME THINGS OLD — SOME THINGS NEW" — Continued from Page 9

school has remained in its traditional undergraduate place, but now has the company of professional schools of education, business, pharmacy, government, and others. In these schools the direction and control of the profession always has been and remains exceedingly strong.

In contradistinction the influence of the engineering profession and its technical societies on engineering education has been and remains at low level; what there is, is exercised chiefly through the device of accreditation. The needs of the profession and the industry it serves are subjects of conferences and discussions, but control of the direction, philosophy, and content of engineering education continues firmly in the hands of educators rather than the profession.

Within the past decade science and engineering have become largely indistinguishable, while much of what was engineering activity a few years ago is now identified as work for technicians. The practitioners of today's technology know and understand what has happened and is continuing; educators are just starting to recognize the change and the implications it holds for both liberal and science and engineering education; while society as a whole understands little of what is happening but fears what it sees.

The United States is no longer isolated in the world, neither is it alone with its problems of technology and education. Wherever one chooses to look one finds the position of a nation in today's world almost a direct reflection of that nation's position in technology. There appears no alternative to acceptance of the fact that our society and its future depend on education in engineering and science adequate to meet and surpass the challenge of those who believe in a different way of life than do we.

TOMORROW

We are not meeting this challenge today -- and the longer we delay facing the realities of the situation, the higher the probability we cannot maintain our way of life.

What about the future?

I believe we can, and must improve our position, and that it can be done without damage to humanity, to our society, or to liberal education.

There is grave doubt in my mind that ... we can afford assent to maintaining liberal education which ignores the large technology segment of our culture.

As there must be greatly increased opportunity and requirements in liberal curricula for cultivation in science and technology, so must there be increased liberalism in science and engineering curricula. What seems to be desirable and needed is a major overhaul of curricula and educational organization in the light of newly redefined educational objectives.

Among many meritorious educational objectives the most appealing to me is the optimal development of the individual within the sphere defined by his interests and his abilities. I believe the school's greatest responsibility is to awaken the student to his potentialities and provide the means to their realization. It may be noted in passing that few schools would not claim this objective. Yet I defy you to find any number of American institutions of higher education in which the student is not the captive of curricula, course structures, academic shibboleths, and even of professors. The procrustean beds of American education are of many sizes and forms, but they all are procrustean.

The objective can be realized without sacrifice of educational soundness or increased expense (in fact with probable savings). What must be sacrificed are the sacred cows of higher education, the little empires of special interest (and of insecure professors and educational administrators), and the dead hand of educational tradition. The reality of life must enter the classroom - not as an intermittent peristaltic stimulant of the educational process - but as a vital element in the determination of educational goals and their achievement.

Engineering schools have an opportunity not available to other schools for leadership in the review and reappraisal I believe is needed. There is common agreement engineering schools must change, and do so rapidly.

The challenge is clearly defined -- the question is will it be met. I think so. There are a few hopeful signs, not the least of which I immodestly claim is the new approach and program of the School of Engineering and Applied Science of the George Washington University. No curriculum in the nation offers the individual student opportunity for development comparable to that of this new engineering education program. Another is the promising Commission on Engineering Education, including educators, professionals, and industrialists among its membership, and just beginning an ambitious program of activity. Others are the stirrings in many engineering schools toward revision of their objectives and programs. More hopeful would be the marriage of science and engineering in education as they have married in real life. This will require dissolution of the time-honored but illogical and irrational arrangement of convenience between the sciences and the arts in colleges of arts and sciences but without abandonment of the arts. Still more hopeful would be some evidence that liberal educators recognize their need to understand and include technology in liberal education, with the concurrent necessity to reappraise their efforts and objectives.

That there must and soon will be some things new created from some things old in the educational world I have no doubt. That some things old will be lost is necessary; but the things new will certainly recoup the loss — and more. The process preferably should be one of evolution, but the continued pressures of today's world and its needs may force educational revolution if we do not soon undertake improvement on a wide front. We need only the will and the wisdom to cast the future in the pattern we choose rather than have the mold thrust upon us.

CAMPUS NEWS

Dateline-Washington, April 24, 1963. The "event of the year", The George Washington University Engineers' Awards Night was opened this evening in Room 200 of Tompkins Hall. The event, sponsored by the Engineers' Council, was under the able chairmanship of Mr. John Starke. A few highlights of the solemn, yet exciting, event were the following awards:

Outstanding freshman for 1961-1962, presented by Sigma Tau--Mr. Morton Tarragin
Outstanding sophomore for 1961-1962, presented by Tau Beta Pi--Mr. Carlos Alonso
Outstanding seniors for the class of '63, presented by the Engineers' Alumni Association:
  Mr. Fred Hood, B.C.E.
  Mr. Donald Miller, B.E.E.
  Mr. Douglas Jones, B.M.E.
  Mr. Lee Kaminetzky, B.S.E. (math)
Presentation of The Engineers' Past President's Gavel, by the Engineer's Council President for 1963-1964, Mr. Richard Singer, to Mr. Harvey J. Flatt.

The final, and most solemn award presented was the Deacon Ames Memorial Award. Originally called the Theta Tau Activities Award, the name was changed by the members of Theta Tau after the death of Deacon Ames, a revered and respected professor of engineering who was equally honored by those in his community for his unstinting service and leadership. The recipient of the Deacon Ames Memorial Award for 1962-1963 is Mr. Harvey J. Flatt, member of many organizations around the campus, and member of every honor society and fraternity open to students in engineering and applied science.

* * * * * * *

The following people were recently named to The George Washington University Chapter of Pi Delta Epsilon National Honorary Journalism Fraternity:

Mr. Donald Miller
Mr. Douglas Jones
Miss Judith Popowsky
Mr. Harvey J. Flatt

Tapping of these engineering students, and of other new members to the fraternity, was held during the May Day Ceremonies, Friday, May 3, 1963, in Lisner Auditorium.

Announcement:

The "Design Manual of Roller and Silent Chain Drives" is now in use in many design courses of Engineering and Technical Institutes because it is the only authoritative source of this design data. It was compiled by the American Sprocket Chain Manufacturers Association, which is comprised of the major manufacturers of these drives, specifically for the purposes of distributing the information, FREE OF CHARGE, to engineering students whose interests are in the field of design. It is a hard-cover book, 8-1/2 x 11". To get your copy, write to

Lester E. Stybr, Executive Director
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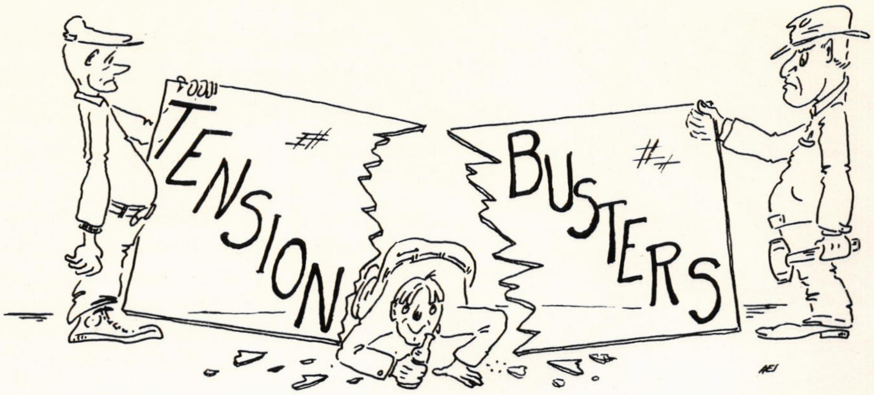

Night Watchman -- "Young man, are you going to kiss that girl?"

Student -- "No, sir."

Night Watchman -- "Well, then hold my lantern."

* * *

Prof -- "What do you find the hardest thing to deal with?"

Stude -- "An old pack of cards."

* * *

Examiner -- "State the number of tons of coal shipped out of the United States in any given year."

Ready-Witted Student -- "1492 --none."

* * *

"I had the girls running in circles when I was in college."

"I never knew you were such a shiek."

"I wasn't. I was women's track coach."

* * *

"Who gave the bride away?"

"Nobody. I could have, but I kept my mouth shut."

* * *

A fellow we know has a broken arm received for fighting for a woman's honor. It seems she wanted to keep it.

* * *

Miss: I told him that I worshipped my figure, and he tried to embrace my religion.

"Let's make a date for Saturday."

"I have a date for Saturday."

"Then let's make it Sunday."

"I'm going out of town Sunday."

"How about Monday, then?"

"Oh, hell, I'll go Saturday."

* * *

A young married student who was father of triplets who being congratulated by a friend. "Oh yes!" he said, "we are devinely happy and it was really wonderful, because you know it only happens once out of 15,786 times."

"Well isn't that just too remarkable," said his friend, "but to save my life I just can't see how you kept up with your studies."

* * *

It doesn't matter how watchful and vigilant a girl is: If a fellow kisses her it is ten to one he'll do it right under her nose.

* * *

There was the little boy who had just gotten a pen pal from Holland. He was so happy about it, that when he came home that night he said cheerfully, "Guess what, Mom? I got a girl in Dutch."

* * *

A man drifting through Lord & Taylor's in New York squeezed one doll and it yelled, "Mama."

He squeezed another doll and it yelled for the floorwalker.

"Marriage," the bartender at the Hob-Nob explained to the young engineer, "is brought about by two people: a single coed and her anxious mother."

* * *

"What kind of a dress did your girl have on last night?"

"I don't remember all the details, but I do know the dress was checked."

"Boy! That must have been some party."

* * *

"So you had a date with an engineer."

"No, I tore my dress on a nail."

* * *

Three engineering students looked at a beautiful girl.

"By golly!" cried the M.E.

"By gum!" cried the C.E.

"By tomorrow night!" sighed the E.E.

* * *

Then there was the fellow who had a hobby of collecting stones and putting them in his bathroom.

He had rocks in his head.

* * *

"What kind of guy is your roommate?"

"Well, last night he stubbed his toe on a chair and said, "Oh, the perversity of inanimate objects."

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This kind of engineer designs jobs instead of things

Once upon a time there was a creature known to jokesmiths as "the efficiency expert." When he wasn't being laughed at, he was being hated. Kodak felt sorry for the poor guy and hoped that in time he could be developed into an honored, weight-pulling professional. That was long ago.

We were then and are much more today a very highly diversified manufacturer. We need mechanical, electrical, chemical, electronic, optical, etc., etc. engineers to design equipment and processes and products for our many kinds of plants, and make it all work. But all the inanimate objects they mastermind eventually have to link up with *people* in some fashion or other—the people who work in the plants, the people who manage the plants, and the people who buy the products. That's why we need "industrial engineers."

A Kodak industrial engineer learns mathematical model-building and Monte Carlo computer techniques. He uses the photographic techniques that we urge upon other manufacturing companies. He collaborates with medicos in physiological measurements, with architects, with sales executives, with manufacturing executives, with his boss (G. H. Gustat, behind the desk above, one of the Fellows of the American Institute of Industrial Engineers). He starts fast. Don Wagner (M.S.I.E., Northwestern '61) had 4 dissimilar projects going the day the above picture was sneaked. He is not atypical. *Want to be one?*

Kodak

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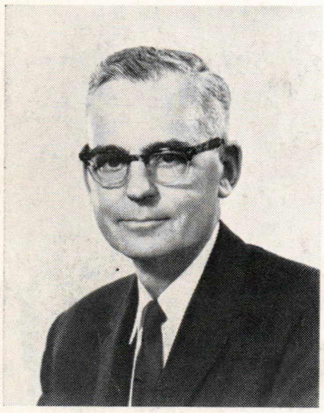
How Industry Tempers Theory with Practice to Get Good Design

An Interview with G.E.'s F. K. McCune, Vice President, Engineering



As Vice President—Engineering, Francis K. McCune is charged with ensuring the effective development, use and direction of General Electric's engineering talent. Mr. McCune holds a degree in electrical engineering and began his career with the Company as a student engineer.

For complete information on opportunities for engineers at General Electric, write to: Personalized Career Planning, General Electric Company, Section 699-07, Schenectady 5, N. Y.

Q. Mr. McCune, how do you define engineering design?

A. First let's look at what engineering really is. The National Society of Professional Engineers calls it "the creation of technical things and services useful to man." I would paraphrase that to add an industry emphasis: engineering is linking an *ability to do* with specific customer *needs and wants.* The link is an engineering design of a useful product or service.

Q. In the light of this definition, how can the young engineer prepare himself for industry?

A. In college he should absorb as much theory as possible and begin to develop certain attitudes that will help him later in his profession. The raw material for a design, information, flows from three general funds: Scientific Knowledge of Nature; Engineering Technology; and what I call simply Other Relevant Information. Academic training places heavy emphasis on the first two areas, as it should. Engineers in industry draw heavily on theorems, codified information, and significant recorded experience basic to engineering disciplines taught in college. The undergraduate must become knowledgeable in these areas and skilled in the ways of using this information, because he will have little time to learn this after graduation. He also must develop a responsive attitude toward the third fund.

Q. As you say, we learn theory in college, but where do we get the "Other Relevant Information"—the third fund you mentioned?

A. This knowledge is obtained for the most part by actually doing engineering work. This is information that *must* be applied to a design to make sure that it not only works, but that it also meets the needs and wants that prompted its consideration in the first place. For example, we can design refrigerators, turbines, computers, or missile guidance systems using only information from the first two funds of knowledge—heat flow, vibration, electronic theory, etc.—and they will work! But what about cost, reliability, appearance, size—will the prospective customer buy them? The answers to these important design questions are to be found in the third fund; for example the information to determine optimum temperature ranges, to provide the features that appeal to users, or to select the best manufacturing processes. In college you can precondition yourself to seek and accept this sort of information, but only experience in industry can give you specific knowledge applicable to a given product.

Q. Could you suggest other helpful attitudes we might develop?

A. Remember, industry exists to serve the needs and wants of the market place, and the reasons for doing things a certain way arise from the whole spread of conditions which a given design has to satisfy. Learn how to enter into good working relationships with people. Much of the Other Relevant Information can be picked up only from others. Also train yourself to be alert and open-minded about your professional interests. In industry you'll be expected to learn quickly, keep abreast in your field, and to grow from assignment to assignment. Industry will give you the opportunity. Your inherent abilities and attitudes will largely decide your progress.

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